**In the Abstract:**

Page 16, lines 4-5, change "an dector" to --a detector--.

## REMARKS

Favorable reconsideration of this application, as presently amended, is respectfully requested.

The Draftsperson's objections to the drawings are noted. The drawings will be corrected upon allowance of the application.

The specification and claim 1 have been amended to correct the informalities noted on page 2, paragraphs 1-3 of the Official Action.

The Abstract has been amended to correct a minor informality.

Claims 1-16 are pending in the present application. Claims 15-16 have been added by the present amendment. Claim 3 was rejected under 35 USC §103(a) as being unpatentable over Kessler '293. Claims 1, 2, 7, 9, 10 and 11 were rejected under 35 USC §103(a) as being unpatentable over Kessler '293 and Fukushima '420. Claim 4 was rejected under 35 USC §103(a) as being unpatentable over Kessler '293 and Fukushima et al.'399. Claim 5 was rejected under 35 USC §103 as being unpatentable over Kessler '293 and Fukushima '420, further in view of Takatori et al. '085. Claim 6 was rejected under 35 USC 103 as being unpatentable over Kessler '293 and Fukushima '420, further in view of Penunuri '419. Claims 8 and 13 were rejected under 35 USC 103(a) as being unpatentable over Kessler '293 and Fukushima '420, further in view of Watanabe et al. '734.

Briefly, the present invention relates to a low-pass optical filter that is utilized in an electronic imaging system to reduce aliasing or under-sampling artifacts. The filter of the present invention is a physically thin blur filter that is inexpensive and relatively simple to manufacture, yet produces a tightly controlled blur pattern that is not dependent upon polarization techniques. The apparatus of the present invention includes an image sensor which generates an image signal from an array of photosites and an optical section that has a birefringent uniaxial crystal optical filter interposed in a path of the incident light to produce a blurred image on the photosites.

Referring to the rejection of claim 3 under 35 USC §103(a) as being unpatentable over Kessler '293; and the rejection of claims 1, 2, 7, 10 and 11 under 35 USC 103(a) as being unpatentable over Kessler '293 and Fukushima '420, the above-noted references are not believed to anticipate or make obvious the specific features required by the pending claims, which have been amended where appropriate to include clarifying changes.

First, as discussed in the specification, when crystal quartz plates are used for filters, the assembly tends to have a large thickness due to the small birefringence of crystal quartz. Furthermore, in conventional arrangements, the thickness required to achieve a desired blur requires a lens with a long, back focal distance in order to make room for the blur filter in the optical path. The present invention provides for a physically thin blur filter that provides a tightly controlled blur pattern that is not dependent upon polarization techniques.

Claim 3 requires an imaging apparatus that generates an image signal from incident light with higher spatial frequencies of the incident light limited to reduce undersampling artifacts. The apparatus of claim 3 comprises an image sensor for generating the image signal from an array of photosites; and an optical section that has a birefringent uniaxial crystal optical filter interposed in a path of the incident light to produce a blurred image on the photosites. As further required by claim 3, the birefringent uniaxial crystal optical filter is made of calcite.

As noted in the Office Action, the reference to Kessler '293 fails to disclose a birefringent uniaxial crystal optical filter made of calcite. Further, with respect to Kessler '293, this reference deals with a biaxial crystal. The use of a biaxial crystal is the core of Kessler '293 and biaxial crystals have two crystal axes. On the other hand, the claimed uniaxial crystal of the present invention has one crystal axis. Biaxial crystals differ from uniaxial crystals, such as quartz, calcide and lithium niobate. The physical phenomenon utilized in Kessler '293 is the conic refraction of biaxial crystals, which is not possible with uniaxial crystals. In conic refraction, a spot of light is transformed by the crystal into a ring of light. When using a uniaxial crystal, a spot of light is transformed by double refraction into two spots for the two polarizations. For an effective anti-aliasing filter, at least two double refractors are commonly used since two spots are not enough for efficient anti-aliasing. Kessler '293 teaches that only one biaxial piece can be used as an efficient anti-aliasing filter. Thus, Kessler '293 has no bearing on the present invention and cannot be combined with the remaining patents which deal with uniaxial crystals.

The specific combination of elements as set forth in claim 3 permits the presentation of a physically thin blur filter, while at the same time, produces a tightly controlled blur pattern that is not dependent upon polarization techniques. That is, in the arrangement set forth in claim 3, a reduced thickness filter can be realized by using a birefringent uniaxial crystal optical filter, which is made of calcite. Kessler '293 discloses a substantially transparent biaxial crystal blur filter. There is no suggestion in Kessler '293 of a birefringent uniaxial crystal optical filter made of calcite having the specific features noted in claim 3.

Additionally, absent Applicants' disclosure, one having ordinary skill in the art would not have provided for the specific arrangement of claim 3.

Claim 1 sets forth that the birefringent uniaxial crystal optical filter is greater than 0.05, while claim 2 sets forth that the birefringent uniaxial crystal optical filter is made of lithium niobate. As discussed in the specification, these features provide for a minimization of the thickness of the blur filter. That is, the birefringence of lithium niobate is utilized to minimize the thickness of the blur filter. Applicants note that these features are not believed to be shown or suggested in the applied references. Although Fukushima '420 suggests that birefringent elements can be made of calcite or lithium niobate, this reference is not believed to show or suggest the specific combination of features required by the claims, including the utilization of a large birefringent uniaxial crystal optical filter to reduce the thickness of the blur filter.

Further, with respect to Fukushima '420, Applicants note that the filter in this reference is not an anti-aliasing filter as in CCD cameras. Fukushima '420 is discusses wavelengths, i.e., spectral filtering by means of polarization components such as double refractors, i.e. crystal optics. Applicants note that in the present application, the problems solved, the functionality and the field of use of the filters are different than that disclosed in Fukushima '420. Lithium niobate is used heavily as a material of choice for TV channel selection. The use of lithium for this surface acoustic application and other applications as in Fukushima '420 is believed to be different from the use in the present invention which utilizes the lithium for anti-aliasing in, for example, CCD cameras. Additionally, as discussed above, since Kessler '293 relates to the use of a biaxial filter, absent Applicants' disclosure, one having ordinary skill in the art would not have combined the above-noted references.

Accordingly, Kessler '293 is not believed to anticipate or make obvious the specific features required by claim 3; additionally, Kessler '293 and Fukushima '420, whether considered individually or in combination, are not believed to anticipate or make obvious the specific features required by claims 1 and 2.

Claims 7 and 9-11 depend either directly or indirectly from claim 1 and set forth further unique features of the present invention, which are also not believed to be shown or suggested in the applied references. More specifically, claim 7 further defines the optical filter as being comprised of a first plate and a second plate of lithium niobate, while claim 9 sets forth that a thickness of the first plate is not equal to a thickness of the second plate. Claims 10 and 11 set forth further unique features of the blurred image, as well as the optical section, which are also not believed to be shown or suggested in the applied references.

Accordingly, dependent claims 7 and 9-11 are also believed to be allowable.

Referring to the rejection of claim 4 under 35 USC §103(a) as being unpatentable over Kessler '293 and Fukushima et al '399, claim 4 sets forth that the birefringent uniaxial crystal optical filter is made of lithium tantalate. As noted in the Office Action, the reference to Kessler '293 fails to disclose that the birefringent uniaxial crystal optical filter is lithium tantalate. Also, as discussed above, Kessler '293 relates to a biaxial crystal as opposed to a birefringent uniaxial crystal. The reference to Fukushima et al '399 is not believed to show or suggest the specific combination of elements of claim 4 which permit the inexpensive and simple production of thin blur filters, while producing a tightly controlled blur pattern. Therefore, absent Applicants' disclosure, one having ordinary skill in the art would not have provided for a birefringent uniaxial crystal optical filter that is made of lithium tantalate as required by the claimed invention.

Accordingly, Kessler '399 and Fukushima et al '399, whether considered individually or in combination, are not believed to anticipate or make obvious the specific features required by claim 4.

Referring the rejection on claim 5 under 35 USC §103(a) as being unpatentable over Kessler '293 and Fukushima '420, further in view of Takatori et al '085, claim 5 sets forth that an angle between an optical axis of the optical filter and a line normal to a filter facet is 37.85°. As discussed in the specification, this angle is chosen to align the retarder plane with a major principle crystal direction so as to facilitate the growing of crystals. The reference to Takatori et al '085 sets forth a specific preferred angle of 35.2° to achieve a desired incident angle. The benefits as set forth in Takatori et al '085 is realized for large incidence angles. Also, Takatori et al '085 does not consider lithium or realize the importance of the claimed cut. There is no teaching or suggestion in the applied references for the specific combination of elements required by the claimed invention, including the claimed angle which simplifies the production of the filters and provides for a reduced thickness filter. The combination of the claimed angle and lithium crystal used in the field of anti-aliasing camera filters permits the use of a large number of boules, which are grown at a reduced cost.

Accordingly, Kessler '293, Fukushima '420 and Takatori et al '084, whether considered individually or in combination, are not believed to anticipate or make obvious the specific features required by claim 5, as well as claim 14, which has been discussed in the Office Action with respect to claim 5.

Referring to the rejection of claim 6 under 35 USC §103(a) as being unpatentable over Kessler '293 and Fukushima '420, further in view of Penunuri '419, claim 6 requires that the optical filter be cut from a boule so that a

crystal axis is at 37.85° to a boule axis asymmetry. The specific combination of the crystal axis being 37.85° and the optical filter being cut from a boule is not believed to be shown of suggested in the reference to Penunuri '419, which relates to the general concept of providing a boule of piezoelectric material, orienting the boule to provide a boundary condition matched to a partially-metalized surface, and sawing the boule into a slice having first and second surfaces. Further, Penunuri '419 relates to cutting a crystal such as lithium niobate at angles suitable for surface acoustic devices. The present invention relates to an anti-aliasing filter, which can be used in, for example, a CCD camera.

Accordingly, Kessler '293, Fukushima '420 and Penunuri '419, whether considered individually or in combination, are not believed to anticipate or make obvious the specific features required by claim 6.

Referring to the rejection of claims 8 and 13 under 35 USC §103(a) as being unpatentable over Kessler '293 and Fukushima '420, further in view of Watanabe et al '734, claim 8 relates to a thickness of the first plate being equal to a thickness of the second plate; while claim 13 sets forth features of the birefringent uniaxial crystal optical filter being comprised of two double refractors. Watanabe et al '734 discloses a color image pickup device in which an image is separated into individual colors by a striped filter. Watanabe et al '734 does not deal with the issue of achieving thin plates by the use of high birefringence crystals such as lithium niobate, nor does Watanabe et al '734 rotate a rhomboid. In Wantanabe et al '734 there is only a one-dimensional aliasing problem. Therefore, Watanabe et al '734, whether considered individually or in combination with Kessler '293 and Fukushima '420, is not believed to show or suggest the specific combination of elements required by the claims, including the features of the optical filter being made of highly birefringent uniaxial crystal that is selected from a group comprised of lithium niobate, lithium tantalate and calcite, and the specific features of the angles of the rhomboidal pattern as required by the claimed invention.

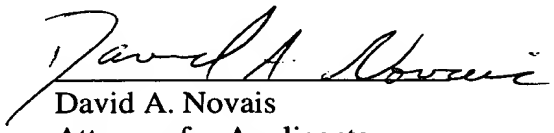
Accordingly, Kessler '293, Fukushima '420 and Watanabe et al '734, whether considered individually or in combination, are not believed to anticipate or make obvious the specific features required by claims 8 and 13.

The present response also adds new dependent claims 15-16, which depend from claim 7 and set forth further unique features of the present invention. Claim 15 sets forth that the second plate comprises a plane which is tilted at a 45° angle to a plane of the first plate, while claim 16 sets forth that each of the first and second plates is coated with an anti-reflective coating as described on page 8, as well as the paragraph bridging pages 8-9. The above-cited

references are not believed to show or suggest the features required by claims 15 and 16 as described above.

In view of the foregoing comments, it is submitted that the inventions defined by each of claims 1-16 are patentable, and favorable reconsideration of this application is therefore requested.

Respectfully submitted,



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